IN THE CLAIMS:

Please **CANCEL** claims 28, 35, and 51 without prejudice or disclaimer, **REPLACE** claims 1, 4, 7, 10, 23, 26, 27, 29, 30, 34, 36, 40, 41, 44, 46, 49, 53, and 55, and **ADD** claims 59-63, as follows:

1. (ONCE AMENDED) A catadioptric projection system for receiving light from a reticle and projecting a pattern from the reticle onto a substrate, the catadioptric projection system comprising:

a first imaging system that forms an intermediate image of an illuminated region of the reticle, the first imaging system comprising in order from the reticle and along an optical axis of the first imaging system, (a) a single-pass lens group comprising a first negative subgroup, a positive subgroup, and a second negative subgroup, and (b) a double-pass lens group comprising a concave mirror, wherein light from the illuminated region of the reticle passes through the single-pass lens group and the double-pass lens group, reflects from the concave mirror, and returns through the double-pass optical group;

a first turning mirror placed near the intermediate image that receives the light reflected by the concave mirror and returned through the double-pass optical group; and

a second imaging system that receives the light reflected by the first turning mirror and that re-images the intermediate image to form a final image of the illuminated region of the reticle on the substrate.

4. (ONCE AMENDED) The catadioptric projection system of claim 2, wherein the second negative subgroup of the single-pass lens group comprises a lens element with a concave surface facing the double-pass lens group.

7. (ONCE AMENDED) The catadioptric projection system of claim 1, further comprising a third turning mirror placed between the single-pass lens group and the double-pass lens group and that receives light from the single-pass lens group and directs the light to the double-pass lens group.

10. (ONCE AMENDED) A catadioptric projection system for receiving light from a reticle and projecting a pattern from the reticle onto a substrate, the catadioptric projection system comprising:

a first imaging system that forms an intermediate image of an illuminated region of the reticle, the first imaging system comprising from objectwise to imagewise, (a) a single-pass lens group comprising a first negative subgroup, a positive subgroup, and a second negative subgroup, and (b) a double-pass lens group comprising a concave mirror, wherein light from the illuminated region of the reticle passes through the single-pass lens group and the double-pass lens group, reflects from the concave mirror, and returns through the double-pass lens group;

a first turning mirror placed near the intermediate image, the first turning mirror separating the light propagating from the double-pass lens group from the light propagating to the double-pass lens group; and

a second imaging system that receives the light reflected by the concave mirror and reflected back through the double-pass lens group and that re-images the intermediate image to form a final image of the illuminated region of the reticle on the substrate.

18. (ONCE AMENDED) A method for projecting a pattern from a reticle onto a substrate, comprising the steps of:

(a) providing a first imaging system comprising a single-pass lens group including from objectwise to imagewise, a first negative lens subgroup, a positive lens subgroup, and a second negative lens subgroup; and a double-pass lens group comprising a concave mirror;

(b) transmitting light from the reticle through the single-pass lens group and the double-pass lens group to the concave mirror, and returning the light reflected from the concave mirror back through the double-pass lens group toward the single-pass lens group;

(c) separating the light propagating through the double-pass lens group to the concave mirror from the light propagating through the double-pass lens group from the concave mirror;

(d) with the first imaging system, forming an intermediate image of the pattern between the first imaging system and the second imaging system;

(e) directing the light propagating from the concave mirror through the second imaging system; and

(f) forming an image of the reticle on the substrate with the second imaging system.

23. (ONCE AMENDED) The method of claim 18, further comprising:

providing a first turning mirror placed between the single-pass lens group and the double-pass lens group; and

directing light, returning through the double-pass lens group from the concave mirror, to the second imaging system using the first turning mirror.

26. (ONCE AMENDED) An exposure system for projecting patterns on a reticle onto a substrate, the system comprising:

(a) a catadioptric projection system that receives an illumination flux from an illuminated region on the reticle and forms an image of the illuminated region on the reticle on a corresponding region on the substrate;

(b) the catadioptric projection system comprising a first imaging system and a second imaging system, the first imaging system forming an intermediate image of the illuminated region of the reticle, and the second imaging system serving to re-image the intermediate image to form an image of the illuminated region of the reticle on the corresponding region of the substrate;

(c) the first imaging system comprising from objectwise to imagewise, (i) a single-pass lens group comprising a first negative subgroup, a positive subgroup, and a second negative subgroup; and (ii) a double-pass lens group comprising a concave mirror, wherein light from the illuminated region of the reticle passes through the single-pass lens group and the double-pass lens group, reflects from the concave mirror, and returns through the double-pass lens group;

(d) a first turning mirror situated near the intermediate image, the first turning mirror separating the light propagating from the double-pass lens group from the light propagating to the double-pass lens group; and

(e) a reticle scanner and a substrate scanner for respectively scanning the reticle and substrate synchronously to allow the catadioptric projection system to project the patterns on the reticle onto the substrate.

27. (ONCE AMENDED) A catadioptric imaging optical system in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, the system comprising:

a catadioptric imaging optical sub-system comprising an optical group to form an image of the pattern, the optical group comprising a concave mirror with a first optical axis; and

a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane to re-image the image formed by the catadioptric imaging optical sub-system, the dioptric imaging sub-system comprising a second optical axis,

wherein

the first optical axis and the second optical axis are not parallel to each other,

the first plane and the second plane are arranged to be parallel to each other,

the optical group of said catadioptric imaging optical sub-system comprises a first optical subgroup comprising a third optical axis, and a second optical subgroup comprising the concave mirror and the first optical axis, and

the second and third axes form a straight optical axis.

28 29. (ONCE AMENDED) A catadioptric imaging optical system according to claim 27, wherein the third optical axis and the second optical axis are parallel to each other.

29 30. (ONCE AMENDED) A catadioptric imaging optical system according to claim 27, wherein the second optical subgroup comprises a negative lens and a positive lens.

34. (ONCE AMENDED) A catadioptric imaging optical system according to claim 33, further comprising a second turning mirror arranged in an optical path between the concave mirror and the first plane.

35 36. (ONCE AMENDED) A catadioptric imaging optical system according to claim 34, wherein the third optical axis and the second optical axis intersect.

38 40. (ONCE AMENDED) A method of imaging a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

forming an intermediate image of the pattern on the reticle using a catadioptric imaging optical sub-system, wherein the catadioptric imaging optical sub-system comprises an optical group comprising a concave mirror with a first optical axis; and

re-imaging the intermediate image formed by the catadioptric imaging optical sub-system onto the substrate using a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane, wherein the dioptric imaging sub-system comprises a second optical axis,

wherein

the first optical axis and the second optical axis intersect,

the first plane and the second plane are arranged to be parallel to each other,

the optical group of said catadioptric imaging optical sub-system comprises a first optical subgroup comprising a third optical axis, and a second optical subgroup comprising the concave mirror and the first optical axis, and

the second and third optical axes form a straight optical axis.

39. 41. (ONCE AMENDED) A catadioptric imaging optical system used in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

a catadioptric imaging optical sub-system in an optical path between the first plane and the second plane, the catadioptric imaging optical sub-system comprising

a first optical group with a lens with a first optical axis, and

a second optical group with a concave mirror with a second optical axis; and

a dioptric imaging sub-system with a third optical axis arranged in an optical path between said catadioptric imaging optical sub-system and said substrate,

wherein

the first optical axis and second optical axis intersect,

the second optical axis and the third optical axis intersect, and

the first and third optical axes form a straight optical axis.

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43 44. (ONCE AMENDED) A method of imaging a pattern on a reticle onto a substrate, comprising:

passing a light from the reticle through a first optical group comprising a lens with a first optical axis;

forming an intermediate image by a light passing through the first optical group and a second optical group, the second optical group comprising a concave mirror with a second optical axis; and

guiding a light having passes through the second optical group to the substrate by passing the light through a dioptric imaging optical sub-system with a third optical axis,

wherein

the first optical axis and the second optical axis intersect,

the second optical axis and the third optical axis intersect, and

the first and third optical axes form a straight optical axis.

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46. (ONCE AMENDED) A catadioptric imaging optical system used in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

a first turning mirror arranged in an optical path between the first plane and the second plane;

a concave mirror arranged in an optical path between the first turning mirror and the second plane;

a second turning mirror arranged in an optical path between the concave mirror and the second plane; and

a dioptric imaging optical sub-system arranged in an optical path between the second turning mirror and the second plane and comprising an optical axis,

wherein

the first plane and the second plane are arranged to be parallel to each other, and

a first reflection surface of the first turning mirror and a second reflection surface of the second turning mirror are arranged to be non-parallel with each other.

~~49~~. (ONCE AMENDED) A method of imaging a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

reflecting a light from the reticle with a first reflection surface of a first turning mirror;

reflecting the light from the first turning mirror with a concave mirror;

reflecting the light from the concave mirror using a second reflection surface of a second turning mirror;

passing the light from the second turning mirror to the substrate through a dioptric imaging optical sub-system having an optical axis;

forming an intermediate image of the pattern in an optical path between the concave mirror and the dioptric imaging optical sub-system; and

forming an image of the intermediate image on the substrate by the dioptric imaging optical sub-system,

wherein

the first plane and the second plane are arranged in parallel to each other, and

the first and second reflection surfaces are arranged to be non-parallel with each other.

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53. (ONCE AMENDED) A catadioptric imaging optical system used in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

a catadioptric imaging optical sub-system in an optical path between the first plane and the second plane, the catadioptric imaging optical sub-system comprising

a first optical group with a lens with a first optical axis, and

a second optical group with a concave mirror with a second optical axis; and

a dioptric imaging sub-system with a third optical axis arranged in an optical path between the catadioptric imaging optical sub-system and the second plane,

wherein

the first optical axis and second optical axis intersect, and

the second optical axis and the third optical axis intersect

the first and third optical axes are parallel to each other, and

the first and third optical axes form a straight optical axis.

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54. (ONCE AMENDED) A method of imaging a pattern on a reticle onto a substrate, comprising:

passing a light from the reticle through a first optical group comprising a lens with a first optical axis;

forming an intermediate image by a light passing through the first optical group and a second optical group, the second optical group comprising a concave mirror with a second optical axis; and

guiding a light having passes through the second optical group to the substrate by passing the light through a dioptric imaging optical sub-system with a third optical axis,

wherein

the first optical axis and the second optical axis intersect, and

the second optical axis and the third optical axis intersect.

the first and third optical axes are parallel to each other, and

the first and third optical axes form a straight optical axis.

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59. (NEW) A catadioptric imaging optical system in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, the system comprising:

a catadioptric imaging optical sub-system comprising an optical group to form an image of the pattern, the optical group comprising a concave mirror with a first optical axis; and

a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane to re-image the image formed by the catadioptric imaging optical sub-system, the dioptric imaging sub-system comprising a second optical axis,

wherein

the first optical axis and the second optical axis are not parallel to each other,

the first plane and the second plane are arranged to be parallel to each other, and

the dioptric imaging optical sub-system further comprises an aperture stop.

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60. (NEW) A catadioptric imaging optical system in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, the system comprising:

a catadioptric imaging optical sub-system comprising an optical group to form an image of the pattern, the optical group comprising a concave mirror with a first optical axis; and

a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane to re-image the image formed by the catadioptric imaging optical sub-system, the dioptric imaging sub-system comprising a second optical axis;

wherein

the first optical axis and the second optical axis are not parallel to each other,

the first plane and the second plane are arranged to be parallel to each other,

the optical group of said catadioptric imaging optical sub-system comprises:

a first subgroup comprising a third optical axis, and

a second subgroup comprising the concave mirror and the first optical axis, and

the third optical axis and the second optical axis intersect.

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61. (NEW) A method of imaging a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

forming an intermediate image of the pattern on the reticle using a catadioptric imaging optical sub-system, the catadioptric imaging optical sub-system comprising an optical group comprising a concave mirror and a first optical axis; and

re-imaging the intermediate image formed by the catadioptric imaging optical sub-system onto the substrate using a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane, the dioptric imaging sub-system comprising a second optical axis,

wherein

the first optical axis and the second optical axis intersect,

the first plane and the second plane are arranged to be parallel with each other, and

the dioptric imaging sub-system comprises an aperture stop.

62. (NEW) A method of imaging a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, comprising:

forming an intermediate image of the pattern on the reticle using a catadioptric imaging optical sub-system, the catadioptric imaging optical sub-system comprising an optical group comprising a concave mirror and a first optical axis; and

re-imaging the intermediate image formed by the catadioptric imaging optical sub-system onto the substrate using a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane, the dioptric imaging sub-system comprising a second optical axis,

wherein

the first optical axis and the second optical axis intersect,

the first plane and the second plane are arranged to be parallel with each other, and

the optical group of the catadioptric imaging optical sub-system comprises a first subgroup comprising a third optical axis, and a second subgroup comprising the concave mirror and the first optical axis, and

the third optical axis and the second optical axis intersect.

63. (NEW) A catadioptric imaging optical system in a projection exposure apparatus that transfers a pattern on a reticle which is arranged in a first plane onto a substrate which is arranged in a second plane, the system comprising:

a catadioptric imaging optical sub-system comprising an optical group to form an image of the pattern, the optical group comprising a concave mirror with a first optical axis;

a dioptric imaging sub-system arranged in an optical path between the catadioptric imaging optical sub-system and the second plane to re-image the image formed by the catadioptric imaging optical sub-system, the dioptric imaging sub-system comprising a second optical axis;

a first turning mirror arranged in an optical path between the concave mirror and the dioptric imaging optical sub-system; and

a second turning mirror arranged in an optical path between the concave mirror and the first plane,

wherein

the first optical axis and the second optical axis are not parallel to each other,

the reticle and the substrate are arranged to be parallel to each other,

the optical group of said catadioptric imaging optical sub-system comprises:

a first subgroup comprising a third optical axis, and

a second subgroup comprising the concave mirror and the first optical axis; and

the third optical axis and the second optical axis intersect.